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#5

TDK FERRITE ABSORBER

ELECTROMAGNETIC SHIELDING AND ABSORBING
MATERIAL MOST WIDELY USED IN:

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SPACE COMMUNICATION SYSTEMS
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RADIO WAVE SCREENING DEVICES
AND OTHER APPLICATIONS

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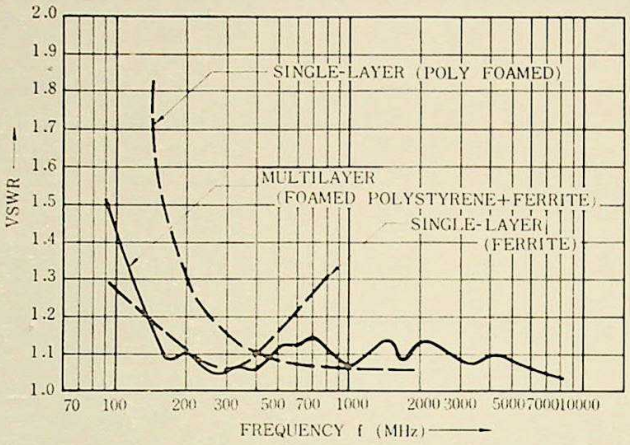


Fig. 10 VSWR vs. frequency curves of single- and multi-layer absorbers

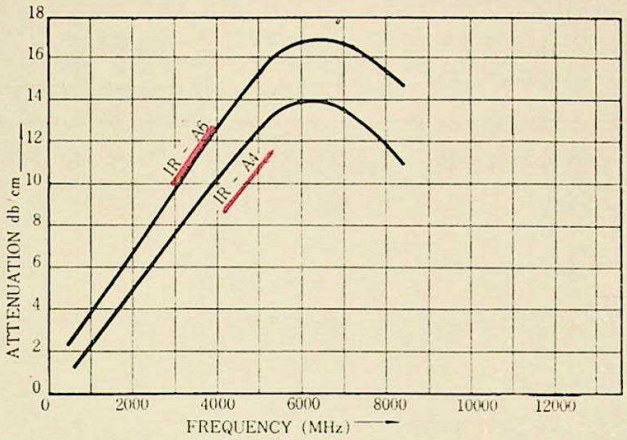


Fig. 11 Attenuation vs. frequency curves of mixture ferrite absorbers

● Block diagram of testing circuit for absorber characteristic

Transmission attenuation absorbers (mixture ferrite)

● Principle of absorption

When an electromagnetic wave passes through an absorber, part or all of the energy is lost in the absorber. The energy loss is classified into ohmic loss, dielectric loss, and magnetic loss. When a plane-polarized wave is incident to an absorber (which has both dielectric and magnetic loss properties) placed in a plane perpendicular to the direction of propagation of the wave, attenuation α occurring in the absorber is given by

$$\alpha = \frac{38.6}{\lambda}\left\{ (|\dot{\varepsilon}_r| \cdot |\dot{\mu}_r|) - (\varepsilon_r'\mu_r' - \varepsilon_r''\mu_r'') \right\}^{\frac{1}{2}} \cdots\cdots (1)$$

[dB/unit length]

where λ: the wave length of the incident wave

$\dot{\varepsilon}_r = \varepsilon_r' - j\varepsilon_r''$ the relative complex permitivity

$\dot{\mu}_r = \mu_r' - j\mu_r''$ the relative complex permeability

● Mixture ferrite

The mixture ferrite used as an incident-wave attenuation absorber (transmission loss type) possesses the properties of both ferromagnetic material and powdered ferrite and organic material which is a good electrical insulator. Since ferrite exhibits a large magnetic loss for waves in UHF-band and higher frequencies, the component μ_r'' of the complex relative permeability of the mixture ferrite generally dominates the attenuation given by the equation (1). Therefore, the mixture ferrite serves as a good incident-wave attenuation absorber for radio waves in UHF-band and higher frequencies.

The IR absorber is a mixture ferrite using neoprene synthetic rubber as the organic material to contain powdered ferrite. Since this material is flexible, it can be cut into various shapes such as long strips, circular sheets, and tubular forms, and thus, IR absorber is suitable for such applications as the material to fill up the gaps through which radiations leak out.

The mixture ferrite is applicable in the frequency range from the UHF band up to 10 GHz. Fig. 11 shows typical attenuation vs. frequency curves of IR absorbers.

Designation	Electromagnetic properties						Physical properties		
	Complex relative permeability		Complex relative permitivity		Attenuation [db/cm]	Resistivity [Ω-cm]	Tensile strength [kg/cm²]	Stretchability [%]	Hardness [deg]
	μ_r'	μ_r''	ε_r'	ε_r''					
IR-A0	1.0	0.0	3.1	0.18	0.3	8.0×10^{12}	40	500	50
IR-A1	1.2	0.2	3.5	0.19	1.2	8.0×10^{12}	31	400	54
IR-A2	1.4	0.6	4.4	0.20	3.0	6.0×10^{12}	29	400	58
IR-A3	1.6	1.2	5.5	0.24	5.2	7.5×10^{11}	24	390	63
IR-A4	1.7	1.7	6.4	0.29	6.9	2.5×10^{11}	23	100	78
IR-A5	1.8	2.0	7.0	0.32	7.8	5.0×10^{10}	22	60	87
IR-A6	1.9	2.4	7.6	0.34	8.4	3.0×10^{9}	15	55	90
IR-A7	2.1	2.5	8.6	0.38	16.6	8.5×10^{7}	—	—	—

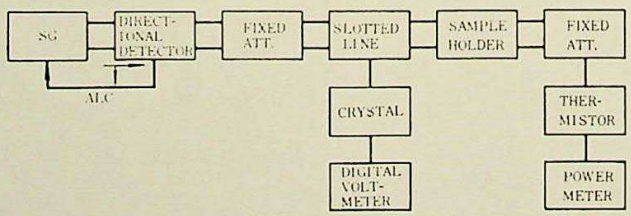
Note: 1) The values of $\mu_r' \mu_r'' \varepsilon_r' \varepsilon_r''$ and Attenuation columns are measured with a test frequency at 2.5 GHz.

2) The values in the Resistivity column are measured with high resistor meter by applying 500V AC across the specimen.

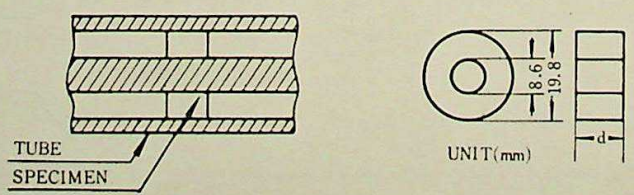
3) The physical properties have been measured in accordance with JIS-K-6301.

Measuring method transmission attenuation

Testing circuit block diagram

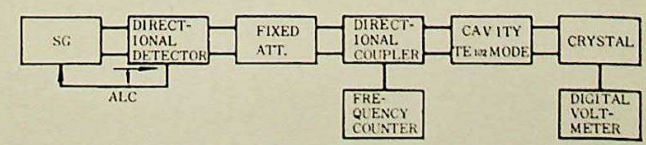


Specimen holder (WX20D Coaxial Tube and dimensions of specimen



Method:

The slotted line is placed to measure the voltage standing wave ratio in front of the specimen. This is to discriminate the attenuation of transmission energy passing through the specimen from the attenuation due to the energy portion reflected by the specimen. Attenuation is indicated on the poowermeter using a thermistor.

Measuring method complex permability and complex permitivity

Testing circuit block diagram